SCHOOL OF CIVIL ENGINEERING

INDIANA DEPARTMENT OF HIGHWAYS

JOINT HIGHWAY RESEARCH PROJECT

JHRP-86-15

ENGINEERING SOILS MAP OF SHELBY COUNTY, INDIANA

FINAL REPORT

John L. Tyree

civil

PURDUE UNIVERSITY

Final Report

ENGINEERING SOILS MAP OF SHELBY COUNTY, INDIANA

TO: H. L. Michael, Director
Joint Highway Research Project

October 14, 1986

Project No: C-36-51B

FROM: Robert D. Miles, Research Engineer
Joint Highway Research Project

File: 1-5-2-79

The attached final report entitled "Engineering Soils Map of Shelby County, Indiana" completes a portion of the long-term project concerned with the development of a county engineering soils map of each of the 92 counties of the State of Indiana. This is the 79th report of the series. The report was prepared by John L. Tyree, Research Assistant, Joint Highway Research Project.

Mr. Tyree developed the engineering soils map using stereoscopic aerial photographs, available literature, available bridge and roadway soil borings, and limited field studies. Generalized soil profiles of the major soils of each landform - parent material area are presented on the engineering soils map attached. The map and report are of value in planning and developing engineered facilities in Shelby County.

Sincerely,

Robert D. Miles

Robert D. Miles, P.E.
Research Engineer

RDM/rrp

cc: A.G. Altschaeffl
J.M. Bell
M.E. Cantrall
W.F. Chen
W.L. Dolch
R.L. Eskew
J.D. Fricker
M.K. Hunter
D.E. Hancher
J.P. Isenbarger
J.R. McLaughlin
K.M. Mellinger
R.D. Miles
P.L. Owens
B.K. Partridge
G.T. Satterly
C.F. Scholer
K.C. Sinha
J.R. Skinner
C.A. Venable
E.W. Walters

Final Report

ENGINEERING SOILS MAP OF SHELBY COUNTY, INDIANA

by

John L. Tyree
Research Assistant

Joint Highway Research Project
Project No.: C-36-51B
File No.: 1-5-2-79

Prepared as Part of an Investigation

Conducted by

Joint Highway Research Project
Engineering Experiment Station
Purdue University

in cooperation with
Indiana Department of Highways

Purdue University
West Lafayette, Indiana

October 14, 1986

ACKNOWLEDGMENTS

The author is especially grateful to Professor R.D. Miles, professor in charge, for his advice and guidance in the research, mapping, and report writing undertaken in this project. The author also wishes to recognize Professor H. L. Michael, Director, Joint Highway Research Project, and the other members of the Joint Highway Research Board for their continued support of the engineering soil mapping project.

The author would also like to acknowledge the other student with whom he had the pleasure to work on this project, Ignatius Okonkwo, for his friendship and technical assistance. Special recognition goes to draftsman, Xiao Gong Wang for his excellent work, and finally to Julia Jordon, Rita Pritchett, Marian Sipes, and Dawn Leverknight for their secretarial skills.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ENGINEERING SOILS MAP

OF

SHELBY COUNTY, INDIANA

INTRODUCTION

The engineering soils map of Shelby County was prepared at a scale ratio of 1:63,360 primarily by interpretation of aerial photographs. Accepted techniques of observation were used to delineate landform - parent material associations by stereoscopic inspection [1]. The aerial photographs used were taken for the U.S. Department of Agriculture in September 1941 and were purchased from the U.S.D.A. They were printed at a scale of 1:20,000 (1 mile = 3 inches).

The Agricultural Soil Survey of Shelby County [2] was used as a reference to confirm soil boundaries. A field trip was taken to the county to verify interpretations made from the aerial photographs. The text of this report includes a general description of the area, and a discussion of the engineering soil areas and problems associated with the soils and bedrock in the county. Standard symbols developed by the staff of the Airphoto Interpretation Laboratory, School of Civil Engineering, Purdue University, were employed to distinguish landform - parent material associations and surface soil textures on the map. The shallow soil profiles of the different landform - parent materials were constructed from information obtained from the Shelby County Soil Survey, field sampling, and borehole records.

DESCRIPTION OF THE AREA

General

Shelby County is located in the east-central part of Indiana (see Figure 1). A photomosaic of the county is given in Figure 2. The county is rectangular stretching 24 miles in the north-south direction and 17 miles in the east-west direction. It has an area of 408 square miles (261,120 acres). It is bordered by six other counties: Hancock to the north, Rush to the east, Decatur to the southeast, Bartholomew to the south, Johnson to the west, and Marion to the northwest. Shelbyville, the county seat and largest city, is located near the center of the county. A summary of the populations of the cities and the county is given in Table 1. About nine-tenths of the acreage of the county is used for farming [2].

Table 1. Population of Shelby County [3].

Location	Population		Population Change	
	1980 Census	1970 Census	Difference	Percentage
Morristown	989	836	+151	+18.02
Shelbyville	14,989	15,094	-105	-0.70
Cities & Towns	15,978	15,932	+46	+0.29
Rural Areas	23,909	21,865	+2,044	+9.35
County Total	39,887	37,797	+2,090	+5.53

Figure 1. Location Map of Shelby County.

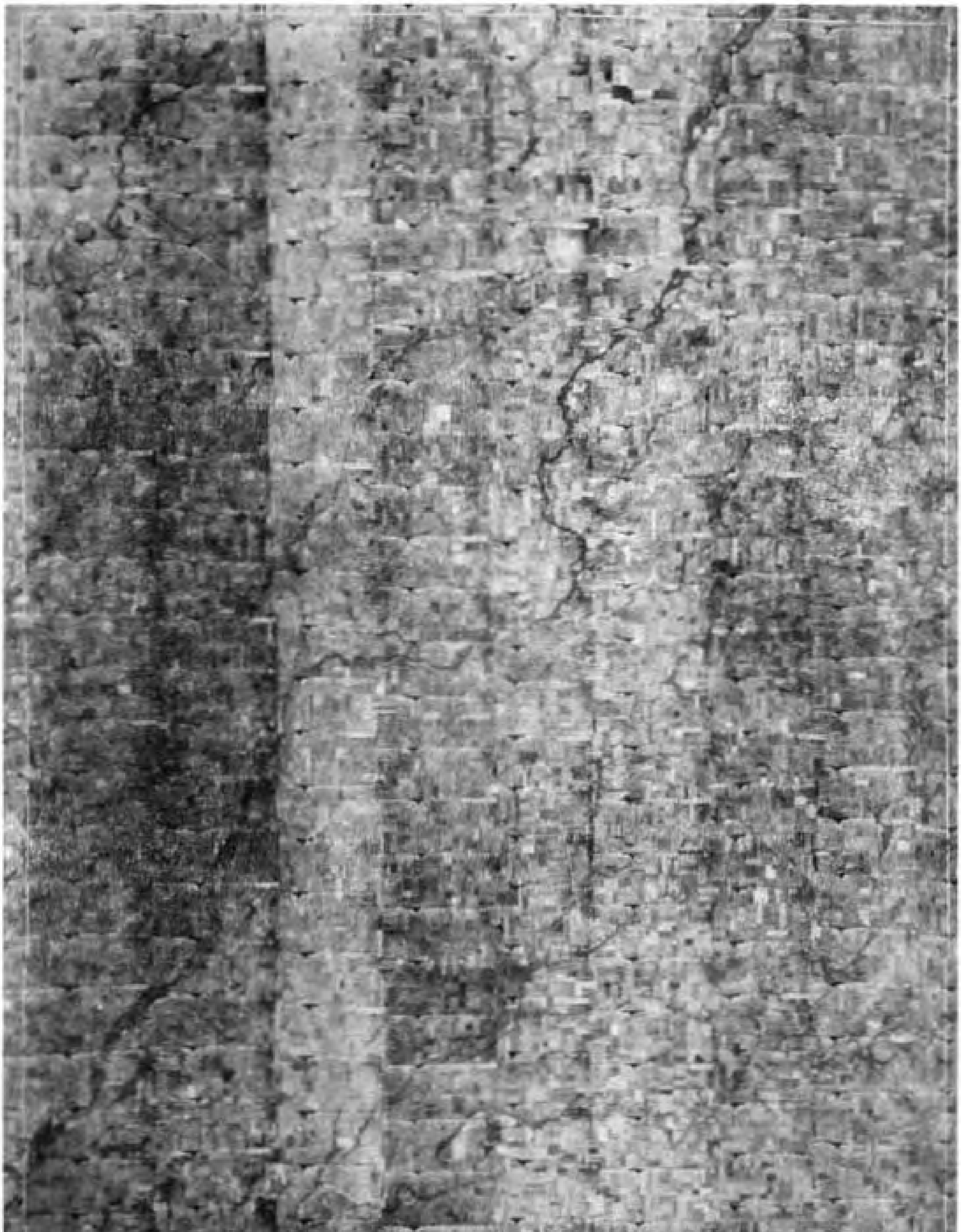


Figure 2. Photomosaic of Shelby County, Indiana

Climate

Shelby county has four well defined seasons including hot summers and cold winters. Air currents of both tropical and polar origin cause frequent changes in temperature and humidity and fairly constant rainfall.

Table 2 gives data on temperature and precipitation. The temperature reaches $90^{\circ}F$ or higher an average of 13 days per year. In the winter, temperatures fall below zero an average of four days per year. January is usually the coldest month of the year with July being the warmest.

Precipitation averages 40.1 inches per year with slightly above average amounts occurring in April and May (near 4 inches) and slightly below average amounts occurring in October and December. Snowfall occurs only in the winter months with the average number of days having one inch or more of snow cover being 13 days per year.

Prevailing winds are from the southwest during the year, however, in one or two of the winter months, they are predominantly from the west or southwest. Winds are stronger in the daylight hours and average 12 miles per hour in spring and 7 miles per hour in late summer. Thunderstorms occur on an average of about 47 times a year. Eleven tornadoes have been reported between 1916 and 1967.

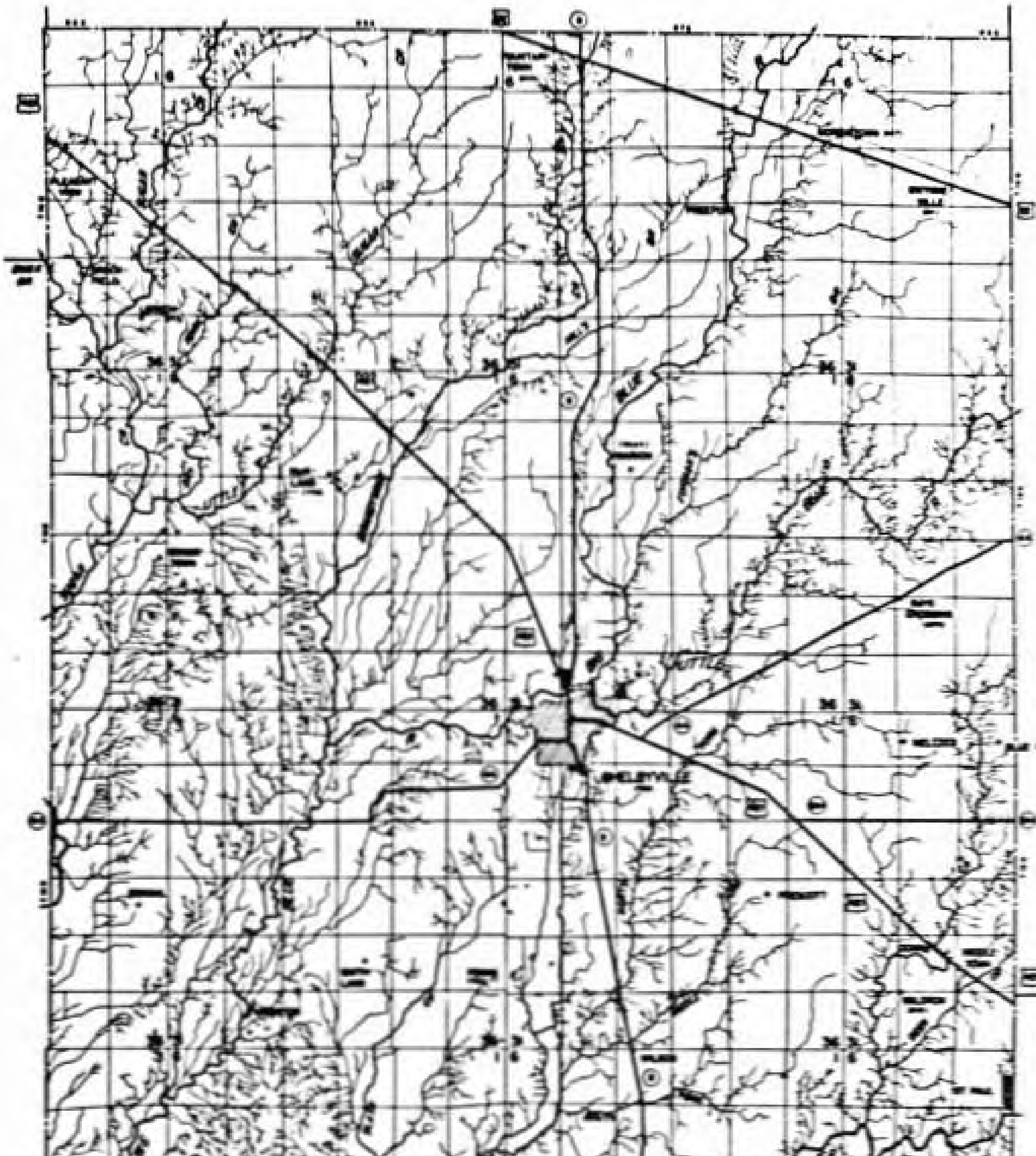
TABLE 2. Climatological Summary for Shelby County (2)

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Average monthly maximum	Average monthly minimum	Average monthly total	1 year in 10 will have— Less than—	1 year in 10 will have— More than—	Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover of 1 inch or more
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January	40	23	61	−1	3.1	0.8	8.0	4	2
February	43	25	63	3	2.5	.6	4.6	3	3
March	52	32	74	13	3.7	1.4	7.7	1	2
April	64	42	83	26	3.9	1.4	7.1	0	0
May	75	52	89	36	4.2	1.5	7.7	0	0
June	85	62	95	46	3.9	1.1	7.0	0	0
July	88	64	97	52	3.8	1.1	6.3	0	0
August	87	63	96	49	3.3	1.7	5.8	0	0
September	80	55	93	38	3.5	.9	7.0	0	0
October	69	45	85	28	2.3	.5	4.5	0	0
November	52	33	73	15	3.2	1.3	6.4	(1)	2
December	41	25	62	3	2.7	.8	5.1	5	3
Year	65	47	[2] 99	[3] −6	40.1	30.7	50.4	13	2

[1] Less than one-half day.
[2] Average annual maximum.
[3] Average annual minimum.

Drainage

Shelby County is included entirely in the Upper East Fork White River drainage basin. The general direction of flow of drainage systems is to the southwest. A drainage map of the county is shown in Figure 3. The principal river in Shelby County is the Big Blue River which enters the county near the northeast corner from Hancock County and flows diagonally to the southwest corner where it enters Johnson County. Big Blue River is fed by Brandywine Creek, which drains the north-central portion of the county, and by the Little Blue River, which drains the east-central portion of the county, and joins Big Blue River at Shelbyville. Nearly forty percent of the county is drained by Flatrock River and its tributaries in the south and southeastern part of the county. The major tributaries to Flatrock River are Slash Creek, Lewis Creek with its three forks, Conns Creek and Deer Creek. Sugar Creek receives runoff from the northwestern part of the county and exits on the east-central border to Johnson County. Little Sugar Creek watershed joins the Sugar Creek watershed north west of Boggstown. The Big Blue River watershed is 576 square miles at the southwest corner where it enters Johnson County and about 345 square miles of the watershed is outside the county to the northeast. The watershed of Flatrock River is about 486 square miles where it enters Bartholomew County on the south and about 303 square miles is outside the county to the east [23].



DRAINAGE MAP
SHELBY COUNTY
INDIANA

Figure 3. [4].

The county has several distinct drainage patterns. The hilly area between Big Blue River and Slash Creek in the southwest has a well developed, dense dendritic pattern. Surface drainage is sparse or nearly absent on the highly porous outwash plains and outwash terraces. The majority of the county is the Wisconsinan till plain which has a normal dendritic pattern and localized mottled or "phantom" drainage patterns. Some streams in the Wisconsinan till plain are "underfit" meaning they are too small to have formed the broad valleys through which they now flow. Tributaries to the Flatrock River where bedrock is shallow tend to be deep and are oriented perpendicular to the River. These tributaries are frequently short, often less than one-half mile long.

There are no natural lakes in Shelby County. Numerous man-made ponds are scattered throughout the county. These are used mainly for erosion control and recreation. A few man-made drainage channels are required in some areas to supplement the natural drainage.

Physiography

Shelby County lies within the central Lowland Province of the United States. Most of the county is in the Tipton Till Plain subdivision. This area is characterized by small elevation differences except for breaks along streams and a few kames. Figure 4 shows the location of Shelby County in relation to the physiographic units. The southern portion of the county is

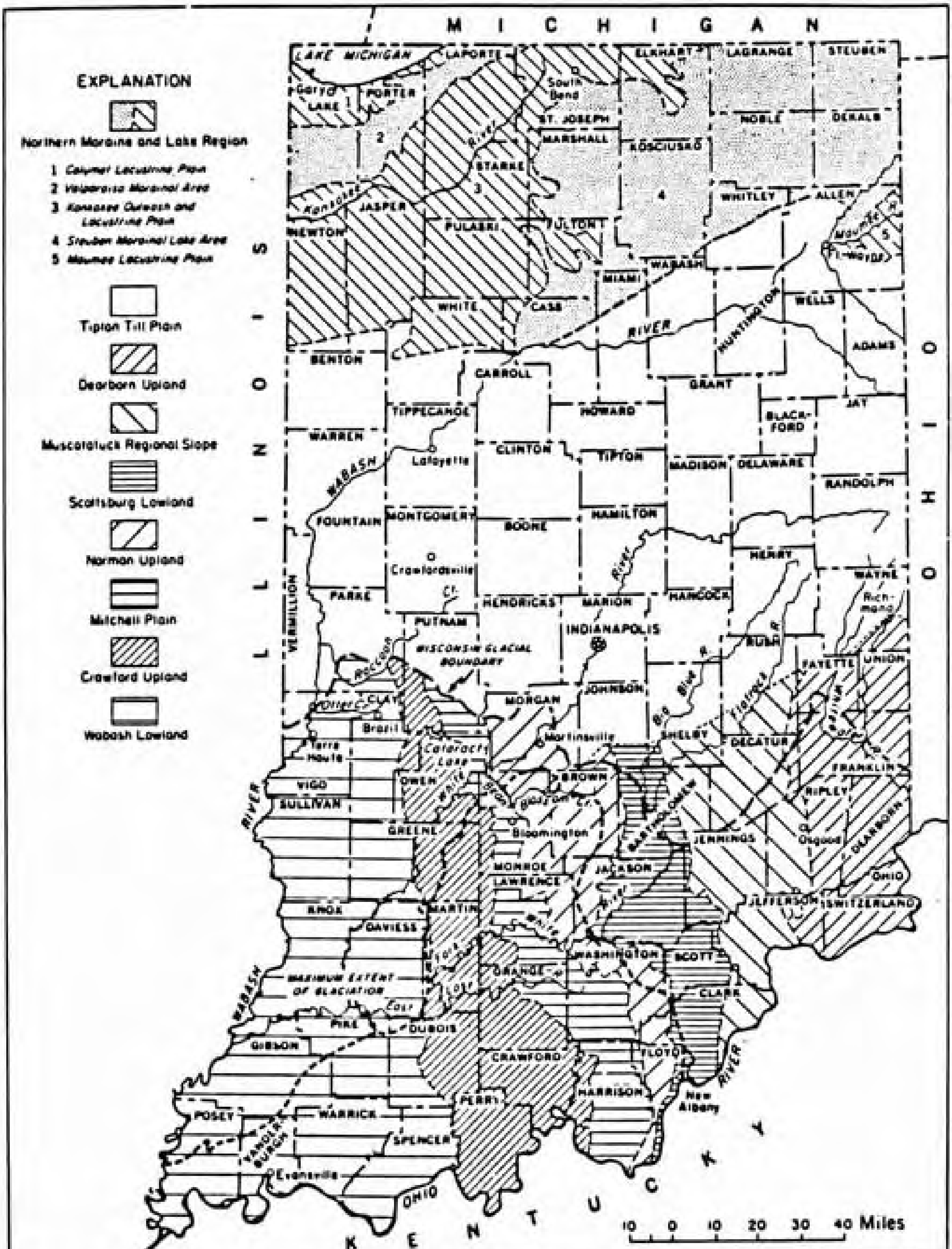


Figure 4. Map of Indiana Showing Physiographic Units and Glacial Boundaries. Modified from Indiana Geological Survey Report of Progress 7, figure 1 (5).

mostly covered with till but has bedrock exposed in the rivers and creeks. This area is the northern most portion of the Muscatatuck Regional Slope. Figure 4 also shows a small area of the Scottsburg Lowland extending into the southwestern part of the county but it is completely covered with till and outwash.

Topography

The topography of Shelby County is flat to moderately hilly. The topography is illustrated in Figure 5. The county has a regional slope of about ten feet per mile down toward the southwest. Elevations are as high as 930 feet above sea level in the northeastern corner of the county and also reach 930 feet just south of Marietta in the southwestern part of the county. The lowest points in the county are where the Big Blue River and Flatrock River exit the county in the southwestern corner and are both at 670 feet.

The wide flood plains and terraces adjacent to the rivers are relatively flat varying less than 10 feet per mile locally. The only major topographic features in these areas exist at the break between the flood plain, terrace and moraine. These topographic breaks are most significant next to flood plains where limestone benches occur. Elevation rises of 30 to 80 feet over a distance of one-quarter mile occur where the flood plains or limestone benches meet the Wisconsinan ground moraine upland.

Elevations in the Wisconsinan ground moraine vary locally from 10 to 60 feet per mile. Some areas have an abundance of

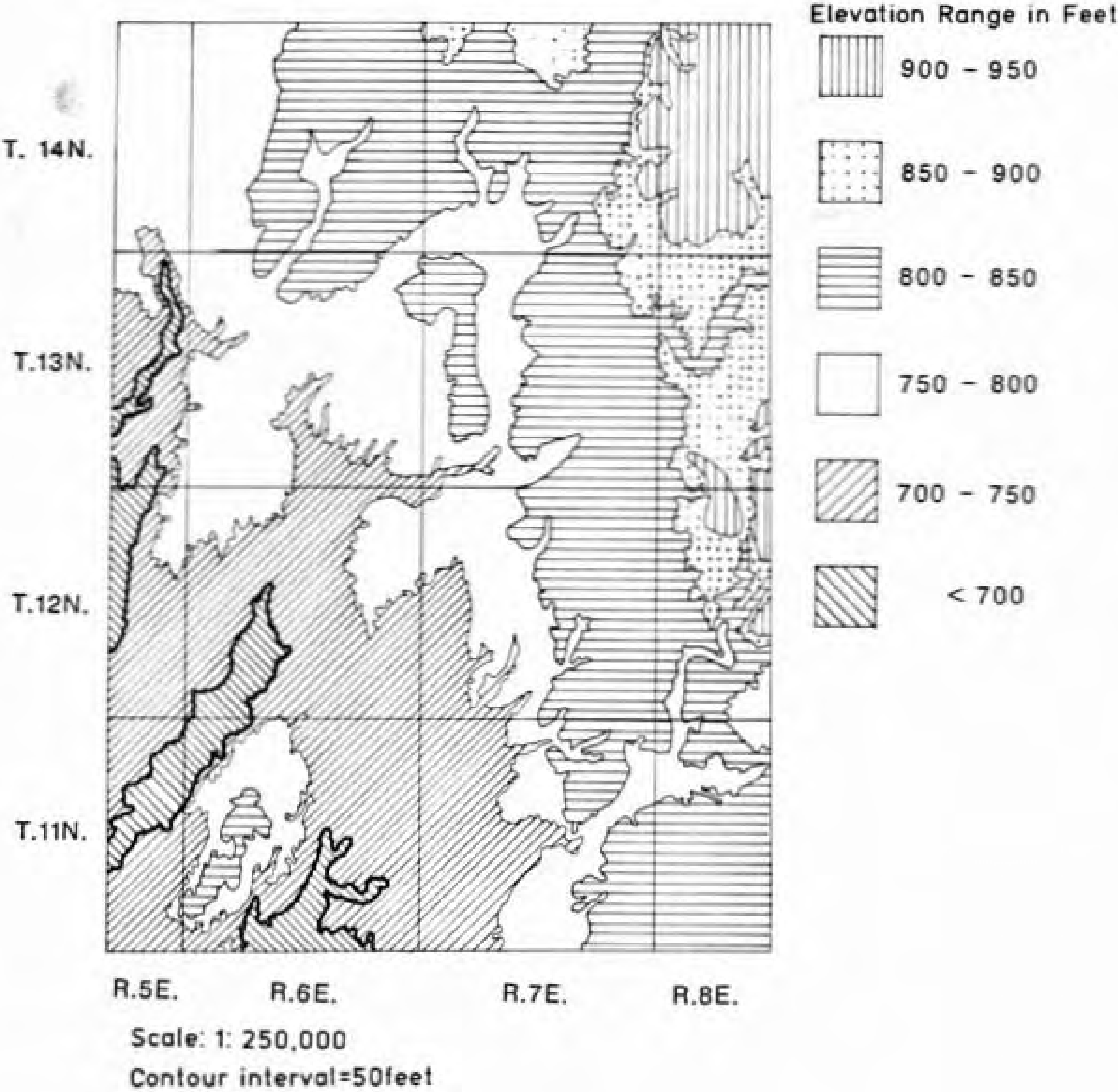


Figure 5. Topographic Map of Shelby County (6).

locally enclosed depressions less than 10 feet deep but are relatively small in surface area. The Wisconsinan ridge moraine area just south of Marietta exhibits the most relief in the county. Elevations reach 930 feet and fall to 700 feet where the moraine meets the outwash terraces which border it on the east and west. Locally, elevations vary from 50 to 120 feet over a distance of one-half mile.

The most pronounced topographic features in the county are the kames. These glacio-fluvial deposits are less than one-quarter mile in diameter but rise above the surrounding ground moraine or ridge moraine as much as 125 feet. Some are only 25 feet high but still can be identified from aerial photographs or in the field. The most prominent ones are located close to Marietta.

General Geology

The geology of Shelby County can be conveniently divided into two parts. The first is the bedrock of Paleozoic age and the second is the unconsolidated glacial and fluvial deposits of Quaternary and Recent age. Most of the bedrock is covered by unconsolidated deposits with the exception of some of the eroded valleys along the Flatrock River and its tributaries.

Bedrock Geology

Shelby County lies on the west flank of a regionally large anticline known as the Cincinnati Arch (see Figure 6). Rock

Figure 6. Bedrock Structure of Indiana. Contours Show Elevation of Top of Trenton Limestone (20).

strata are dipping roughly west at approximately 20 feet per mile. Because of this structural attitude the physiographic units, which reflect the bedrock formations, lie in somewhat parallel north-south strips, in general, for the southern half of the state. Uneven erosion along preglacial valleys has led to an exception to this trend locally in Shelby County.

The bedrock geology is shown in Figure 7. Four rock systems are represented in the county: Mississippian, Devonian, Silurian, and Ordovician. Each system contains one or more bedrock formations which are listed in chronological order in Table 3 along with their respective thicknesses and lithologic descriptions.

The New Albany Shale underlies outwash and glacial till in the southwestern part of the county and is partly in both the Mississippian and Devonian systems. It is an evenly laminated, fissile, carbonaceous shale which weathers into thin plates. The next formation in the Devonian is the North Vernon Limestone. It is a gray coarsely crystalline, crinoidal limestone which commonly has solution cavities. Below this lies the Jeffersonville Limestone. The upper part is light-gray, thickly stratified, fossiliferous limestone and, like the North Vernon Limestone, commonly contains solution cavities. The lower portion is darker and dolomitic in most places and is consequently less cavernous than the upper part of the formation. The lower part of the Jeffersonville Limestone blends into the Geneva Dolomite, which is a brown crystalline dolomite.

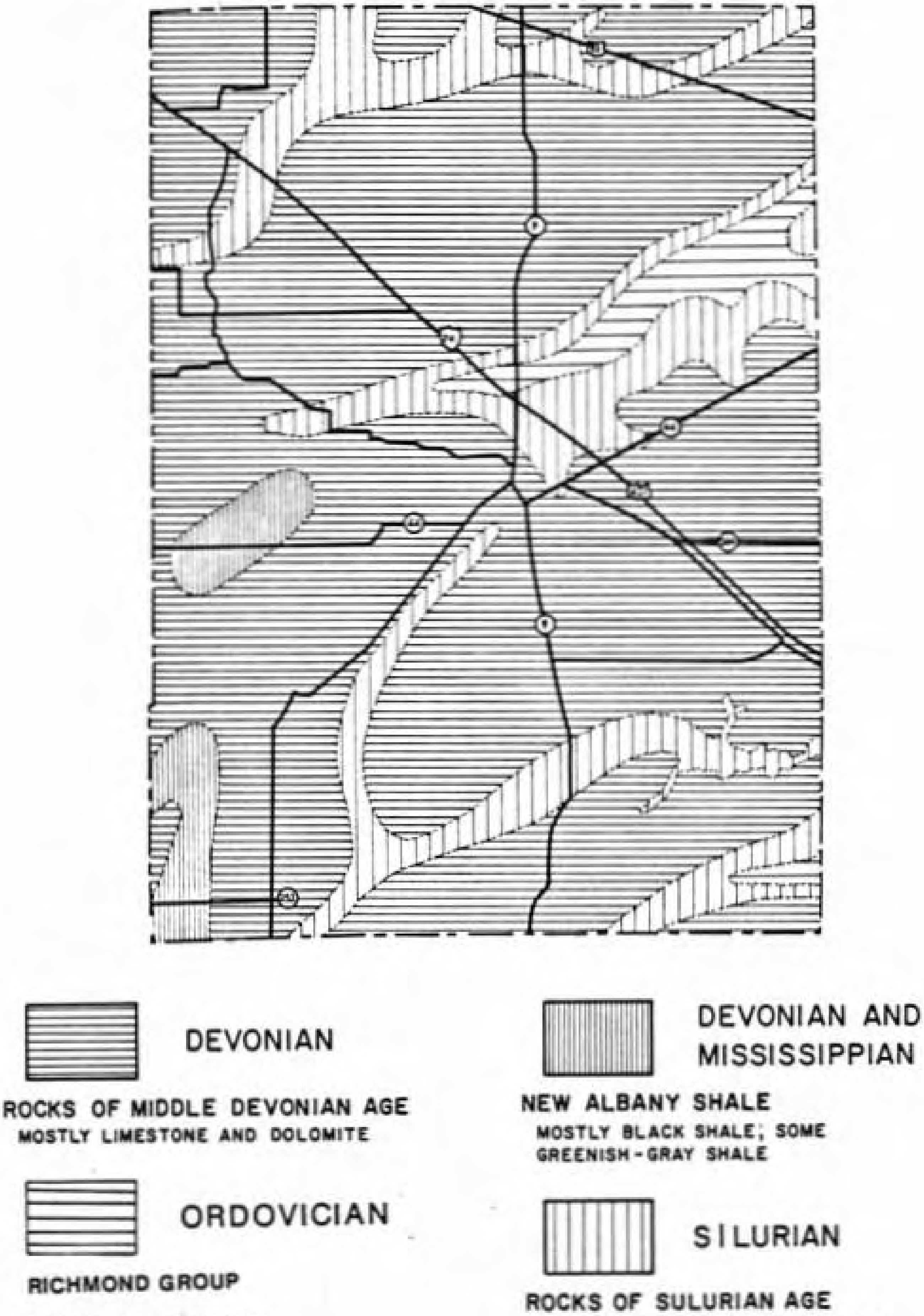


Figure 7. Bedrock Geology of Shelby County (7).

Table 3. Descriptions and Thicknesses of Bedrock Formations in Shelby County [10].

Age	Formation Name	Approximate Thickness	General Description
MISSISSIPPIAN / DEVONIAN	New Albany Shale	120′	gray and brown, evenly laminated, fissile, carbonaceous SHALE, weathers into thin plates
DEVONIAN	North Vernon Limestone	1-3′	gray coarsely crystalline, crinoidal LIMESTONE; solution cavities common
DEVONIAN	Jeffersonville Limestone	35-80′	upper part is light-gray thickly stratified, fossilferous LIMESTONE commonly containing solution features; lower part is tan to brown DOLOMITIC LIMESTONE
DEVONIAN	Geneva Dolomite	30-40′	brown crystalline DOLOMITE; can be much thicker or thinner
SILURIAN	Louisville Limestone	< 45′	gray crystalline, thinly stratified LIMESTONE
SILURIAN	Waldron Shale	< 15′	varies from a gray calcareous SHALE with occasional fossil masses to a thinly interbedded clay SHALE
SILURIAN	Laurel Limestone	50′	light-gray to light yellowish-brown, very finely crystalline, thinly stratified DOLOMITIC LIMESTONE with much chert in the upper part
SILURIAN	Osgood Formation	10-20′	gray, argillaceous LIMESTONE and calcareous SHALE
SILURIAN	Brassfield Limestone	10-20′	cream colored, coarsely crystalline LIMESTONE
ORDOVICIAN	Whitewater Formation	100′	bluish-gray, abundantly fossiliferous, calcareous SHALE

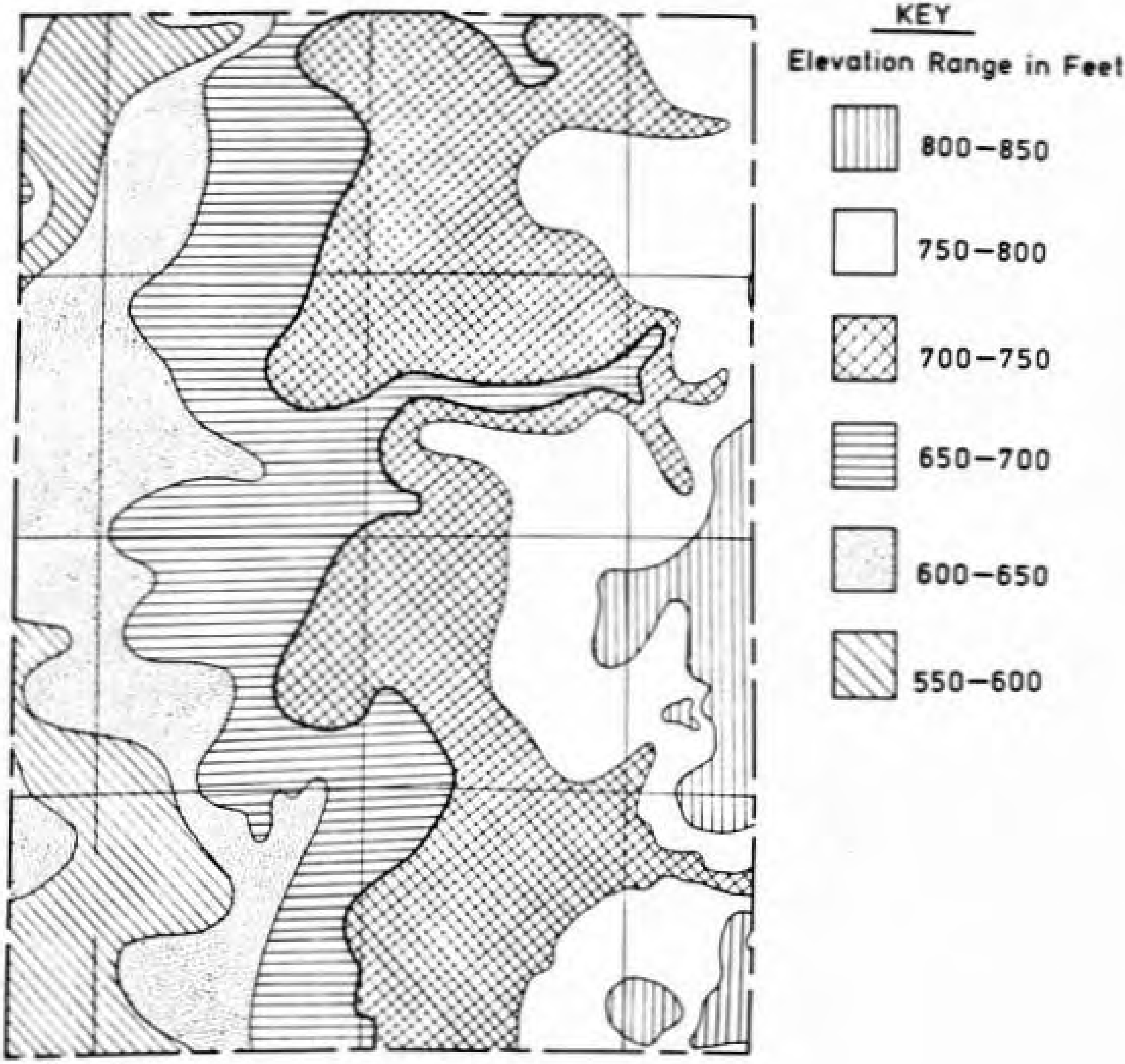
Silurian Formations appear as the top most bedrock unit in preglacial valleys which are oriented southwest-northeast. The upper formation is the Louisville Limestone which is a gray crystalline, thinly stratified limestone and is not known to have solution cavities. Below this lies the Waldron Shale, a gray calcareous shale with occasional localized fossil masses or sometimes a thinly interbedded clay shale. Next, is the Laurel Limestone which is a finely crystalline, thinly stratified, dolomitic limestone. The Osgood Formation, a gray argillaceous limestone and calcareous shale, separates the Laurel Limestone from the Brassfield Limestone, a cream colored, coarsely crystalline limestone with solution cavities uncommon.

The Ordovician system is represented by the Whitewater Formation. It occurs in the eastern part of the county in preglacial valleys and is a bluish-gray, abundantly fossiliferous, calcareous shale.

Figure 8 shows the general topography of the bedrock surface in Shelby County. The general slope towards the west is clearly seen and is disrupted only by the erosion in the preglacial valleys. It is important to note that the surface topography is not always an accurate reflection of the bedrock topography.

Glacial Geology

Recent fluvial materials partially fill some bedrock valleys but the great bulk of unconsolidated deposits are of glacial origin [11]. Of the four glaciation stages which are recognized in



Scale: 1:250,000
Contour interval=50feet

Figure 8. Bedrock Topography of Shelby County (8).

the Midwest, only the deposits of the Illinoian and Wisconsinan glaciations are significant in Shelby County. Figure 9 shows the thickness of unconsolidated deposits in Shelby County. The Illinoian glaciation occurred before the Wisconsinan glaciation and covered the entire county. The glacier deposited ground moraine which filled valleys and smoothed out the landscape. A period of outwash deposition and local erosion followed the retreat of the Illinoian glaciation and a paleosol, a weathered soil profile, can be identified in soil borings in places within the county. The Illinoian ground moraine does not appear at the surface in the county due to the overlying deposits of Wisconsinan Age. The thickness of the Illinoian Till is expected to be roughly one-half to one-third of the thickness of the Wisconsinan Till [12].

Ice of the Wisconsinan glaciation also covered the whole county depositing ground moraine and ridge moraine. Sand and gravel accumulations from fluvial action on the top of the glacier were deposited in the form of conical mounds when the glacier melted. These deposits are known as kames and are distinct from the ground moraine both in topography and grain size distribution. In some places, a significant amount of till were deposited which was left relatively unmodified by the retreating ice forming ridge moraines.

The floodwaters from the melting Wisconsinan glaciation had a significant impact on the deposits in and around the rivers. Tremendous amounts of water scoured the major rivers and streams eroding the glacial till and redepositing sand and gravel outwash

The two agricultural soil series mapped in sand dune areas are Ayrshire and Princeton.

Engineering problems associated with areas mapped as sand dunes include compaction problems, wind erosion, and piping. Roadway embankments and subgrades of wind blown sand require special compaction control. Long term road cuts should be seeded as soon as possible to prevent wind erosion. The high to moderate permeability of the fine sand makes it a poor liner for landfills.

Glacial Landforms

Glacial deposits in Shelby County include Wisconsinan ground moraine and Wisconsinan ridge moraine.

Ground Moraine

Two-thirds of the surface area in Shelby County is covered by Wisconsinan ground moraine. The Wisconsinan ground moraine is characterized by a gently to moderately undulating land surface. Elevation changes vary from 10 to 60 feet over a distance of one mile. Weathered loess 10 to 18 inches thick overlies approximately half of the areas. Aerial photographs revealed a mottled, light-dark pattern with the lower, moister areas being darker.

Surface soils generally consist of a silt loam (A-4 to A-6) to a depth of 7-16 inches. Subsurface soils are silty clay loam and clay loam (A-6) from 31 to 48 inches. Loamy soils with occasional gravel, cobbles, and sand seams typically lie below.

The agricultural soil series formed in Wisconsinan ground moraine in Shelby County are: Brookston, Crosby, Hennepin, and Miami. Engineering test data taken from specific locations are shown in Tables 4a, 4b, and 4c for three depths less than four feet total depth.

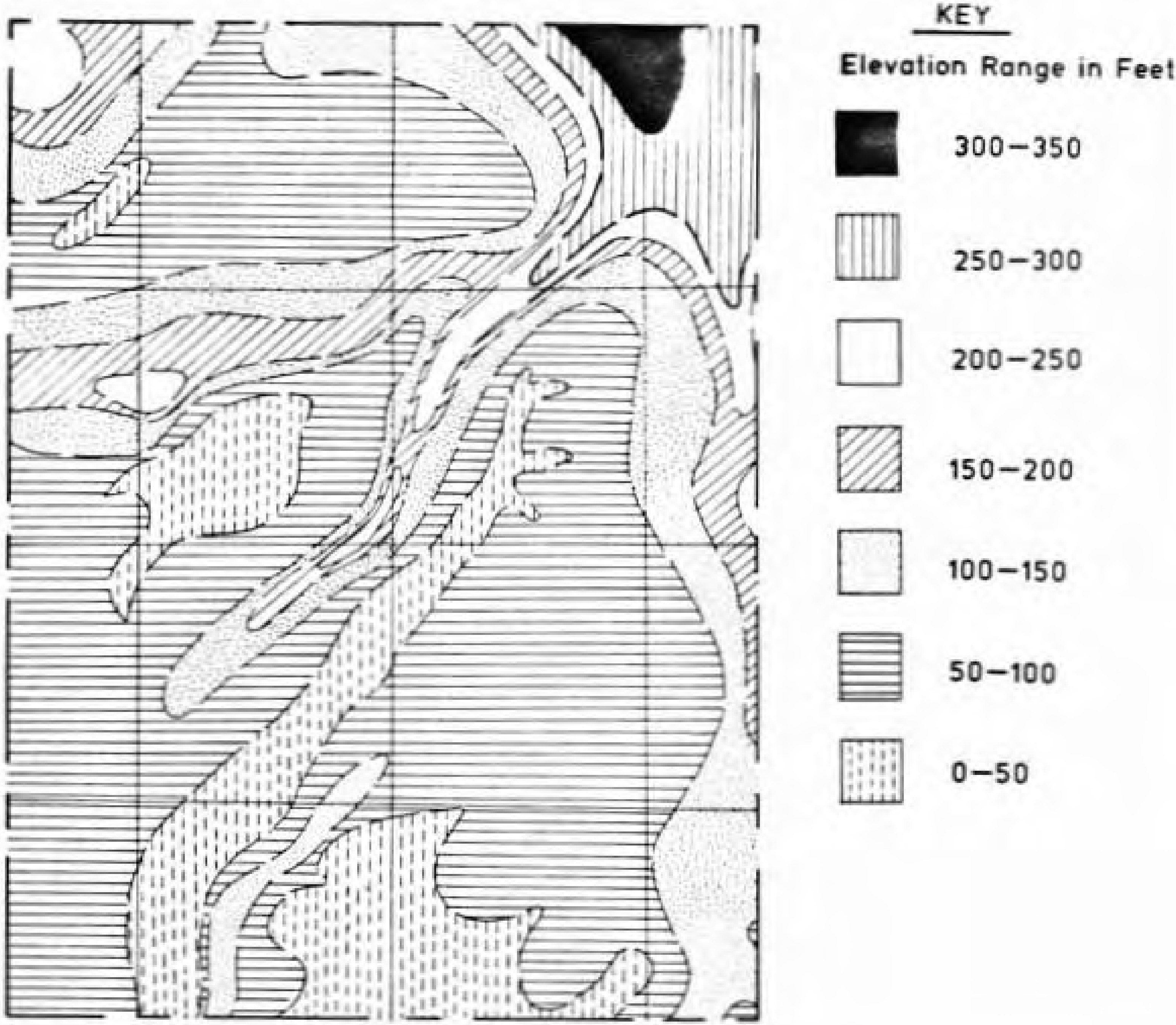
Table 4a. Engineering Test Data from Low Areas of the Wisconsinan Ground Moraine (NE 1/4, NW 1/4, Sec. 7, T.12 N., R.7 E., Shelby County) [21].

Brookston Silty Clay Loam

Depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHTO	UNIFIED	Wopt %	Max γd pcf
0-7	1	26	51	22	43	19	A-7-6(11)	CL	29	89
20-34	-	20	53	27	40	21	A-6(12)	CL	18	108
36-48	6	41	40	13	23	7	A-4(4)	ML-CL	11	122

California Bearing Ratio (AASHTO T87-49 (1))

Depth inches	ω %	γd pcf	CBR at .1" %	CBR at .2" %	Swell %	Surcharge lbs.
0-7	-	-	-	-	-	-
20-34	17	107	6	6	0.44	35
34-48	11	125	20	23	0.11	35



Scale: 1:250,000
Contour interval=50feet

Figure 9. Thickness of Unconsolidated Deposits in Shelby County (9).

in thicknesses over 100 feet in some places. Overflow from the swollen rivers deposited sand and gravel at a distance of one to two miles away from the present channels leaving outwash terraces which stand five to 20 feet above the flood plain. In a few places channels were carved and outwash materials were deposited where no channel existed leaving outwash plains and underfit streams.

Strong, unchecked winds blew sand from the flood plains, outwash terraces, and outwash plains up onto the edges of the till plain forming sand dunes. Most of the dunes are located on the east side of Sugar Creek suggesting the predominant winds were from the west. A thin discontinuous layer of wind blown silt, loess, was deposited on some moraine areas.

LANDFORMS AND ENGINEERING SOIL AREAS

Eolian Landforms

Loess Plain

A thin blanket of loess (wind blown silt) covers parts of the Wisconsinan ground moraine and the Wisconsinan ridge moraine areas. The loess is generally less than 18 inches and weathered making it indistinguishable as a landform parent material. The thin loess is associated with the Crosby silty loam agricultural soil series on the gentle slopes of the ground moraine and the ridge moraine.

Sand Dunes

Sand dunes are concentrated in the south and central parts of the western third of the county. The mapped areas consist of many disconnected, small oblong and rounded shapes. Widths range from one-tenth mile to about one mile. Active dune development is minimal at present.

The dunes formed over Wisconsinan ridge and ground moraine. The dunes are as much as two miles from their outwash terrace source areas, but typically cap the higher ridges on the ground and ridge moraine. The stratigraphic contact between the sand dune deposit and underlying till is expected to be sharp.

One source estimated the average thickness of the sand dunes in the East Fork White River basin to be 15 to 20 feet and in some places as much as 40 feet [10]. Many of the small dunes mapped in Shelby County have only 5 to 10 feet. In these areas, phantom drainage patterns in the underlying Wisconsinan ground moraine show through in the interdunal troughs. Some of the ridges in the Wisconsinan ridge and ground moraine, close to areas mapped as sand dunes, are capped with fine wind blown sand and silt (less than five feet thick).

The parent material of soils formed on sand dunes are predominantly fine, uniform, windblown sands and some silt. The surface soil is a sandy loam (A-4) to a depth of about 22 inches. Sandy clay loam (A-6 to A-4) is found from 22 to 47 inches followed by a thin layer of sandy loam (A-4) which becomes fine sand (A-2) at about 55 inches with occasional silt dominant seams.

Table 4b. Engineering Test Data from Level Areas of Wisconsinan Ground Moraine and Ridge Moraine (NW 1/4, NW 1/4, Sec. 1, T.12 N., R.7 E., Shelby County) [21].

Crosby Silt Loam

Depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHTO	UNIFIED	Wopt %	Max γd pcf
3-10	2	25	60	13	32	8	A-4(8)	OL	20	104
19-34	2	18	41	39	47	27	A-7-6(16)	CL	20	102
39-49	24	36	26	14	18	4	A-4(1)	SM-SC	9	130

California Bearing Ratio (AASHTO T87-49 (1))

Depth inches	ω %	γd pcf	CBR at .1" %	CBR at .2" %	Swell %	Surcharge lbs.
3-10	19	101	5	6	0.09	35
19-34	20	103	8	7	0.24	35
39-49	9	131	8	12	0	35

Table 4c. Engineering Test Data from High Areas of Wisconsinan Ground Moraine and Ridge Moraine (NE 1/4, NE 1/4, Sec. 19, T.12 N., R.8 E., Shelby County) [21].

Miami Silt Loam

Depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHTO	UNIFIED	Wopt %	Max γd pcf
0-7	2	26	54	18	30	8	A-6(7)	OL	17	109
12-27	4	31	31	34	46	28	A-7-6(15)	CL	19	107
38-48	14	46	31	9	14	0	A-4(1)	SM	7	134

California Bearing Ratio (AASHTO T87-49 (1))

Depth inches	ω %	γd pcf	CBR at .1" %	CBR at .2" %	Swell %	Surcharge lbs.
0-7	16	111	5	6	-0.06	35
12-27	17	106	15	12	0.98	35
38-48	7	133	54	59	0.02	35

Wisconsinan ground moraine and ridge moraine are underlain by outwash and/or older glacial till deposits. Total thicknesses of these unconsolidated deposits can be roughly estimated from Figure 9. Engineering test boring results made in areas mapped as Wisconsinan ground moraine can be found in the Appendix (Borings 6, 7, 15, 16, and 24) and on the engineering soils map. These results should be viewed as site specific.

Foundations on the Wisconsinan ground moraine occasionally require undercutting of softer weathered soils. Unweathered soils are typically slightly to highly overconsolidated with natural water contents around 8 to 15 percent. Sand seams bearing water generally do not pose significant dewatering problems in excavations.

Due to the high silt content of the Wisconsinan ground moraine surface soils, properly designed pavements should have a sufficient thickness of base and subbase. Synthetic filter fabrics used for subgrade separation have performed well in preventing intrusion of fines into the base. They should be seriously considered in wet areas or if the subgrade is wet during the time of construction. California Bearing Ratio (CBR) test results taken from specific locations for these silty soils are shown in Tables 4a, 4b, and 4c.

Ridge Moraine

Wisconsinan ridge moraine in Shelby County is found in three places. The first area located in the north-central zone between Blue River and Brandywine Creek has relief similar to the ground moraine with northeast to southwest oriented ridges. Small depressions are very common while the generalized soil profile for this area is expected to be very similar to that for Wisconsinan ground moraine.

The second area is located west of Sugar Creek in the northwestern edge of the county. It has slightly more relief than the Wisconsinan ground moraine. The generalized soil profile is expected to be similar to that of the Wisconsinan ground moraine.

The third area is located in the southwestern corner of the county between Big Blue River and Lewis Creek. This zone has relief which varies from 50 to 120 feet over a distance of 0.5 miles. Surface soils generally consist of silt loam (A-6 or A-4) to a depth of 3 to 14 inches. Subsurface soils typically are silty clay loam and clay loam (A-6) from 12 to 48 inches. Loamy soils with occasional gravel, cobbles, and sand seams lie below. At a depth of 10 to 20 feet calcareous sand and gravel outwash of Illinoian Age is likely to exist [2]. A thin layer of surficial wind-blown sand covers part of the ridge moraine surface areas. Agricultural soil series in areas mapped as ridge moraine include Crosby, Miami, Parke, and Negley.

Road cuts made in the hilly ridge moraine areas will occasionally encounter erosion from increased seepage due to perched water tables. Cut slopes should be seeded as soon as possible to limit erosion.

Glacio-Fluvial Landforms

Kames

Fourteen kames were found in Shelby County. They form the most distinctive topographic landform in the county. The largest ones, almost 125 feet high, are located east of Marietta in the southeast quarter of the county.

A silt loam surface soil was developed on kames. Subsurface soils at a depth of 14 inches consist of clay loam which extends to a depth of about 22 inches. Gravelly clay loam typically lies below to a depth of 54 inches. The underlying parent material is a stratified sand, silt and gravelly sand with occasional till layers. Agricultural soil series formed in kames are Rodman and Fox. Some kames have been utilized as sources of sand and gravel for concrete aggregate and roadway subgrade fill. They do not constitute large reserves but where small quantities are needed, these deposits may be adequate.

Outwash Terrace

Broad coarse-grained outwash deposits occur as terraces along the edges of major river flood plains and tributaries. They extend away from the flood plain as much as 1.5 miles. The terraces stand 4 to 20 feet [2] above the flood plain and possess a distinctive current scar pattern on the aerial photographs. The terraces are extremely flat over several square miles and contain virtually no surface drainage due to the high permeability of the deposit. Numerous infiltration basins occur.

The upper 8 to 14 inches is a loam (A-4 or A-6) which is underlain by clay loam (A-4) or gravelly clay loam (A-2) to a depth of 40 inches. The parent material below generally consists of stratified silty sand, sandy silt, and gravelly sand with occasional cobbles. Till layers of variable thickness commonly are found between outwash deposits. These till layers are typically hard and overconsolidated. Agricultural soil series formed on outwash terraces include Fox, Ninevah, Ockley, Rodman, Sebwewa, Sleeth, and Westland. Results of engineering test borings made in areas mapped as outwash terraces are given in the appendix (Borings 9, 13, 14, 17, 18 and 19) and on the engineering soils map. Engineering test data made at three depths less than five feet in depth are given in Table 5. Soils above 4 feet tend to be highly plastic based on tests at these locations.

Table 5. Engineering Test Data from an Outwash Terrace Boring Location (SW 1/4, SW 1/4, Sec. 35, T.13 N., R.S E., Shelby County) [21].

Ockley Silt Loam										
Depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHTO	UNIFIED	Wopt %	Max γd pcf
0-7	1	39	47	13	26	9	A-4(5)	CL	16	113
27-35	16	39	15	30	60	42	A-7-6(9)	SC	18	107
46-60	42	50	4	4	NP	NP	A-1-a(0)	SP-SM	8	135

California Bearing Ratio (AASHTO T87-49 (1))

Depth inches	ω %	γd pcf	CBR at .1" %	CBR at .2" %	Swell %	Surcharge lbs.
0-7	15	112	2	3	-0.84	35
27-35	18	108	8	7	0.20	35
46-60	8	131	92	101	-0.02	35

Boring Location (SW 1/4, NE 1/4, Sec. 14, T.13 N., R.5 E., Shelby County) [21].

Ockley Silt Loam

Depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHTO	UNIFIED	Wopt %	Max γd pcf
0-8	4	42	52	2	32	9	A-4(4)	ML-CL	16	109
16-29	12	23	16	22	47	27	A-7-6(5)	SC	16	110
46-56	8	77	7	8	NA	NA	A-1-b(0)	SM	12	117

California Bearing Ratio (AASHTO T87-49 (1))

Depth inches	ω %	γd pcf	CBR at .1" %	CBR at .2" %	Swell %	Surcharge lbs.
0-8	17	110	5	7	-0.02	35
16-29	15	110	16	13	2.4	35
46-56	12	117	32	38	0	35

Boring Location (SE 1/4, SW 1/4, Sec. 29, T.13 N., R.7 E., Shelby County) [21].

Nineveh Silt Loam

Depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHTO	UNIFIED	Wopt %	Max γd pcf
0-5	10	41	42	7	35	13	A-6(4)	SM-SC	14	116
13-25	12	57	9	22	51	31	A-2-7(3)	SC	14	112
35-45	42	53	3	2	NA	NA	A-1-A(0)	SW-SM	10	126

California Bearing Ratio (AASHTO T87-49 (1))

Depth inches	ω %	γd pcf	CBR at .1" %	CBR at .2" %	Swell %	Surcharge lbs.
0-5	14	117	5	6	-.002	35
13-25	15	114	7	8	0.07	35
35-45	11	126	62	67	0.04	35

Foundations constructed on the sand and gravel below the zone of weathering can support moderate to heavy loads depending on the soil density. Proper soil exploration should be made in case clayey pockets or loose sands are encountered locally. Excavations extending very far below the water table are likely to require well point dewatering systems to control seepage. In some areas shallow organic surface soils overlie the outwash sand and gravel. Outwash terraces are excellent sources of aggregate. The deposit commonly begins at a shallow depth and extends over 100 feet in places. Potentially deleterious material such as chert, sandstone, shale, siltstone, and limonite typically compose less than 25 percent of the deposit [22]. The chert pebbles generally have a bulk specific gravity near 2.54.

Outwash Plain

Outwash plains are distinguished from outwash terraces by their topography and location relative to their source flood plain. The two main areas of outwash plain are located near the center of the county. They are bordered by Wisconsinan ground moraine and at one time carried water as overflow channels for the tremendous amount of glacier meltwater. The outwash plain northwest of Shelbyville is intertwined with outwash terrace areas. In these areas the outwash terrace stands 5 to 10 feet above the outwash plain.

Surface soils generally consists of clay loam (A-6) or loam (A-4) with clay loam continuing to a depth of 48 inches. The underlying parent material typically is a stratified sandy silt, silty sand, and gravelly sand with occasional cobbles. Hard, overconsolidated till layers of variable thickness and continuity occur within the outwash deposit. Agricultural soil series formed on outwash plains include Martinsville, Negley, Rensselaer, Westland, and Whitaker.

The engineering test data of Table 5 apply to outwash plain areas as well. Small sluiceway channels depressed less than a few feet in the outwash plain may have a thicker layer of fine-grain soils on top. Table 6 illustrates engineering test data taken from one of these sluiceways. Engineering problems associated with outwash terraces also apply to outwash plains.

Table 6. Engineering Test Data from a Sluiceway Area of an Outwash Plain (SW 1/4, SE 1/4, Sec. 26, T.12N., R.6E., Shelby County) [21].

Westland Silty Clay Loam

Depth inches	Grav %	Sand %	Silt %	Clay %	LL %	PI %	AASHTO	UNIFIED	Wopt %	Max γd pcf
4-11	10	41	26	23	48	25	A-7-6(8)	SC	18	105
21-45	10	30	35	25	44	27	A-7-6(12)	CL	18	109
50-60	47	44	3	6	NP	NP	A-1-6(0)	SP-SM	9	131

California Bearing Ratio (AASHTO T87-49 (1))

Depth inches	ω %	γd pcf	CBR at .1" %	CBR at .2" %	Swell %	Surcharge lbs.
4-11	18	106	7	7	0.27	35
21-24	17	110	5	4	0.13	35
50-60	8	128	63	70	0	35

Fluvial Land Forms

Flood Plains

Soil deposits in the flood plains are difficult to characterize due to their potential for variability within relatively short distances and depths. There are two distinctive types of flood plains in the county: the large rivers and smaller tributaries in Wisconsinan ground moraine and the tributaries underlain at shallow depth by limestone bedrock.

(a) Flood Plains in Wisconsinan Moraine

Flood plains in this category have widths up to a mile wide.

The soil profile consists of a variety of well to poorly graded, stratified soils. In some places sand and gravel becomes more dominant with depth since many of the valleys were filled with coarse-grained outwash materials. Several gravel pits located within the flood plains are evidence of abundant sand and gravel below more recent finer-grained deposits. Topographically, the flood plains are very flat with scattered small and shallow depressions. The depressions typically contain finer-grained materials. Organic deposits occur occasionally on the surface and less frequently in the subsoil. The flood plains of some of the smaller tributaries have been exagerated in size to enable them to appear on the map. Alluvial deposition in these areas may be thin or absent. Agricultural soil series formed on flood plains in Wisconsinan ground moraine include Eel, Genessee, Medway, Ross, Saranac, and Shoals. Results of engineering test borings made in these flood plains can be found in the Appendix (borings 8, 10, 11, 20, 21, 22 and 25) and on the engineering soils map.

(b) Flood Plains Over Limestone Bedrock

Flood plains near areas mapped as limestone bench are typically narrow and deep. Elevations drop 30 to 80 feet over a distance of 0.25 miles. The soils consist of stratified fine and coarse-grained materials mixed with rock fragments. The soils are shallow over bedrock and sinkholes occur on the benches.

Bedrock Landforms

Limestone Bench

Soils which formed on limestone benches are primarily in the southeastern corner of the county. The soil is not well developed as a residual soil but is mostly covered with alluvial or colluvial deposits. It is usually covered by thin Wisconsinan ground moraine or slope wash on hilly areas and covered with flood plain deposits on the flatter benches. The limestone benches may also include shale and are subject to frequent erosion and deposition if near flood level.

Soils along the valley slopes have 9 to 11 inches of silt loam (A-4) at the surface. The subsoils typically contain clay, silty clay loam, clay loam with rock fragments to a depth of 15 to 42 inches. Limestone or shale bedrock underlies these shallow soils. Agricultural soil series formed on limestone benches are Corydon, Millsdale, Milton, and Randolph. For more detailed information on the bedrock type, see the geology section of this report. Results of engineering test borings in areas mapped as limestone bench can be found in the Appendix (borings 1, 2, 3, 4 and 5) and on the engineering soils map.

Miscellaneous Landforms

Muck Basins

Several small basins mapped on outwash terraces and outwash plains have up to 42 inches of black muck. The muck is typically in a saturated depression at the base of a slope and is underlain by sand and gravel. The muck is weak and compressible commonly containing some partially decomposed vegetation. The symbol for highly organic topsoil is used to identify these depressions on the engineering soils map.

Gravel Pits and Quarries

Gravel pits in Shelby County are common on the outwash terraces. Several operate in the vicinity of Shelbyville. Several gravel pits occur along Flatrock River. Limestone quarries are located in the southeast corner of the county near Flatrock River and near St. Paul. Both gravel pits and quarries are shown on the engineering soils map with appropriate symbols.

REFERENCES

1. Frost, R.E. et al, "Manual on the Airphoto Interpretation of Soils and Rocks for Engineering Purposes," Joint Highway Research Project, Purdue University, West Lafayette, Indiana, 1943.

2. "Soil Survey of Shelby County, Indiana", U.S. Department of Agriculture, Soil Conservation Service in Cooperation with Purdue University Agricultural Experiment Station, March 1974.

3. Hittle ,J.H., "Population Trends for Indiana Counties , Cities, Towns 1970-1980", Highway Extension and Research Project for Indiana Counties, 1981.

4. Parvis, Merle, "Drainage Map of Shelby County", Project R-63 Soil and Drainage Maps, State Highway Commission of Indiana, Purdue University, February 18, 1948.

5. Map of Indiana Showing Physiographic Units and Glacial Boundaries," Modified from Indiana Geological Survey Report Progress 7, 1948.

6. "Regional Topographic Map, Indianapolis Sheet", prepared by the Army Map Service, Corps of Engineers, U.S. Army, Washington D.C., 1953.

7. Gray, H.H. et al, "Geologic Map of the Cincinnati and Indianapolis 1 x 2 degree Quadrangles Showing Bedrock and Unconsolidated Deposits," Department of Natural Resources, Geological Survey, Bloomington, Indiana, 1972.

8. Gray, H.H., "Map of Indiana Showing Topography of the Bedrock Surface," Indiana Department of Natural Resources, Geological Survey, Bloomington, Indiana, 1982.

9. Gray, Henry H., "Map of Indiana Showing Thickness of Unconsolidated Deposits", Indiana Department of Natural Resources, Geological Survey, 1983.

10. Schneider, A.F., and Gray, H.H., "Geology of the Upper East Fork Drainage Basin", Indiana Department of Natural Resources, Geological Survey Special Report #3, Bloomington, Indiana, April,1963.

11. Logan, W.N., et. al., "Handbook of Indiana Geology," Indiana Department of Conservation, Division of Geology, Indianapolis, Indiana, 1922.

12. Gray, Henry, H., Geologist at the Indiana State Geological Survey, Direct Communications, July 1985.

13. "Subsurface Investigation and Soils Recommendations, Project No. BRZ-9973( ), Structure No. Shelby 10335, Vandalia Road over Flatrock Creek in Shelby County, Indiana", prepared for Indiana Department of Highways by Alt and Witzig, Inc., Indianapolis, Indiana, May 10, 1984.

14. "Report of Roadway Soil Survey, Relocated State Route 9, Project S-563(5), Shelby County, Indiana", prepared for Engineers Associates, Inc., Evansville, Indiana by The H.C. Nutting Company, Cincinnati, Ohio, August 25, 1964.

15. "Soil Profile Survey, State Road 9, Project No. S-296(5)P.E., Shelby, County, Indiana", prepared for Henry B. Steeg & Associates, Indianapolis, Indiana by American Testing and Engineering Company, Indianapolis, Indiana, June 9, 1970.

16. "Subsurface Investigation and Soils Recommendations, Project No. RS-7573( ), Structure No. Shelby 10006, County Road 53 over Big Blue River in Shelby County, Indiana", prepared for Harden Engineers, Nashville, Indiana by Alt & Witzig Engineering, Inc., Indianapolis, Indiana, June 3, 1982.

17. "Report of Roadway Soil Survey, RS-Project No. 848(7)P.E., State Road 44 Three Miles West of Shelbyville in Shelby County, Indiana", prepared by Division of Materials and Tests, Soils Department, Indiana Department of Highways, Indianapolis, Indiana, March 26, 1976.

18. "Soil Profile Survey, I-65-2(68)75 over State Road 252, Shelby County, Indiana", prepared for Shaffer, Parrett and Associates, Indianapolis, Indiana by American Testing and Engineering Corporation, Indianapolis, Indiana, November 16, 1964.

19. "Soil Profile Survey, I-65-3(67)80 P.E., Johnson and Shelby Counties, Indiana", prepared for Boyd E. Phelps, Inc., Indianapolis, Indiana by American Testing and Engineering Corporation, Indianapolis, Indiana, August 5, 1965.

20. Wayne, William J., "Thickness of Drift and Bedrock Physiography of Indiana North of the Wisconsinan Glacial Boundary, Indiana Department of Conservation, Geological Survey, Report of Progress No. 7, 1956.

21. "Engineering Test Data for Shelby County, Indiana" performed for Soil Conservation Service by Purdue University, in cooperation with Indiana State Highway Department et al., August 1962.

22. Carr, Donald D., "Sand and Gravel Resources in Eastern Johnson County and Western Shelby County, Indiana," Department of Natural Resources, Geological Survey Special Report 4, Bloomington, Indiana, 1966.

23. Hoggatt, Richard E., "Drainage Areas of Indiana Streams," Geological Survey, U.S. Department of Interior, 1975.

APPENDIX

This appendix contains various pieces of data collected from borehole records in the county. Concious effort was made to select those boreholes from those available which best illustrate the geology and landform - parent materials of the county. The locations of the boreholes are given by their highway station and offset and also can be found by their numbers on the engineering soils map. The data given is not intended for site specific use as the engineering properties may be different at other localities even if the area of interest lies in the same landform - parent material area.

Some points to consider in using this table of data are:

1. Elevations listed were those at the time of drilling.
2. Textural soil descriptions may or may not reflect quantitative information about soil density. Those boreholes without SPT values probably are much less reliable.
3. Standard penetration test (SPT) values were taken every five feet for most boreholes. Multiple SPT values for one depth range can be assumed to be in order (the first being the top most, etc.).
4. Abbreviations used are: γ_{dmax} = maximum dry density; ω_{opt} = optimum water content; RQD = Rock Quality Determinate (%); pcf = pounds per cubic foot; ω_n = natural water content; CBR = California Bearing Ratio; q_u = unconfined compressive strength.

Appendix (cont.)

Borehole Number	Highway Route	Station	Offset	Surface Elevation	Depth	Soil Description: Texture	Soil Description: AASHO	SPT	LL	PL	PI	Notes
		feet	feet		feet			blows/foot	%	%	%	
BRIDGE ON VANDALIA ROAD OVER FLAT ROCK RIVER [13].												
1	Vandalia Road	12+10	12'L	755	0-4.5	v. loose SANDY GRA trace clay		3				
					4.5-10	v. stiff to med. stiff CLAY LOAM	A-4(3)	20,9				
					10-10.1	v. stiff SANDY CLAY LOAM trace GRA & limestone		18				
					10.1-19	Hard vuggy LIMESTONE						RQD = 45,57
2		14+05	11'R	755	0-0.6	loose SANDY GRA		4				
					0.6-9	soft to med. stiff CLAY LOAM	A-4	6,8				
					9-11.7	med. dense SAND		11				
					11.7-16.7	hard fossilif. vuggy LIMESTONE						RQD = 42
STATE ROAD 9 RELOCATION [14].												
3	SR 9	214+00	CL	745	0-2	stiff SANDY CLAY						
					2-10	med. stiff SANDY LOAM	A-4(0-4)					
					10-11	stiff SILTY LOAM	A-4(5-8)					
4	SR 9	227+64	CL	727	0-4	stiff CLAY LOAM w/GRA	A-6(0-10)					
					4-5	stiff SILTY LOAM	A-4(5-8)					
					5-8	slightly calc. fine grained DOLOMITE		RQD=80				non-fossiliferous slightly weathered
5	SR 9	247+26	CL	724	0-2	stiff CLAY LOAM w/sand seams	A-6(0-10)					
					2-4	med. stiff SANDY LOAM w/ GRA	A-4(0-4)					
					4-6	med. stiff SILTY LOAM	A-4(5)					
6	SR 9	262+00	12'L	765	0-2	med. stiff SANDY CLAY FILL						γ_{dmax} = 105 pcf ω_{opt} = 18.5%
					2-7	med. stiff SANDY LOAM little Gra	A-4(0-4)		17	12	5	γ_{dmax} = 131 pcf ω_{opt} = 9.5%
					7-11	med. stiff CLAY w/Gra	A-6(11-16)		36	13	23	γ_{dmax} = 126 pcf ω_{opt} = 10.3%
7	SR 9	300+00	20'L	764	0-1.5	med. dense SANDY LOAM FILL						
					1.5-9	med. stiff SANDY LOAM w/ sand & gra. seams	A-4(3)		17	12	5	

Appendix (cont.)

Borehole Number	Highway Route	Station	Offset	Surface Elevation	Depth	Soil Description: Texture	Soil Description: AASHO	SPT	LL	PL	PI	Notes
		feet	feet		feet			blows/foot	%	%	%	
STATE ROAD 9 IMPROVEMENT [15].												
8	SR 9	124+00	36'R	755	0-4	med. stiff LOAM	A-4	6	19	10	9	
					4-5	med. dense SANDY LOAM	A-4	16				
					5-10	med. dense GRAVELLY SAND	A-1-6	17,21				
9	SR 9	144+00	25'R	759	0-4	med. stiff LOAM	A-4	7	24	14	10	γ_{dmax} = 115 pcf w_{opt} = 14%
					4-5	loose SANDY LOAM	A-4(0)	6	12	11	1	
					5-10	med. dense GRAVELLY SAND	A-1-6	18,14				
BRIDGE ON COUNTY ROAD 53 OVER BIG BLUE RIVER [16].												
10	CR 53	30+12	15'L	770	0-0.5	Topsoil						
					0.5-4.5	v. stiff CLAY LOAM	A-6	16				
					4.5-8.5	med. dense GRAVELLY SAND	A-1-6	25,29				
					8.5-13	hard CLAY LOAM	A-6	33				
					13-30	hard SILTY CLAY LOAM	A-4	50/.5'				
11	CR 53	33+22	15'L	770	0-6.5	v. loose to loose SANDY LOAM FILL		3,7				
					6.5-13.5	loose to v. loose GRAVELLY SAND	A-1-6	10,5				
					13.5-50	hard CLAY LOAM	A-6	56,45, 41,77				γ_{dmax} = 101 pcf w_{opt} = 17.6%
STATE ROAD 44 3 MILES WEST OF SHELBYVILLE [17].												
12	SR 44	54+20	25'R	719	0-2	med. stiff LOAM	A-6	11				
					2-6.5	med. stiff to stiff SILTY CLAY LOAM	A-6(9)	9	30	19	11	pH = 7.4 q_u at 3.5' - 6.5' were 2034, 1020, 200, 860 psf
					6.5-9	med. stiff LOAM w/tra GRA	A-6	6				
					9-10	med. dense SANDY GRA	A-1-a	15				
13	SR 44	129+00	CL	724	0-1.5	stiff LOAM	A-6	8				
					1.5-10	med. dense SANDY GRA	A-1-a(0)	19,5,12				very loose at 6' pH = 8.0
14	SR 44	150+00	CL	745	0-4	med. stiff LOAM	A-6	7				
					4-8	med. stiff SILTY CLAY LOAM	A-6	10				
					8-15	dense to v. dense SANDY GRA	A-1-a	37,100/.9, 74				10% fines

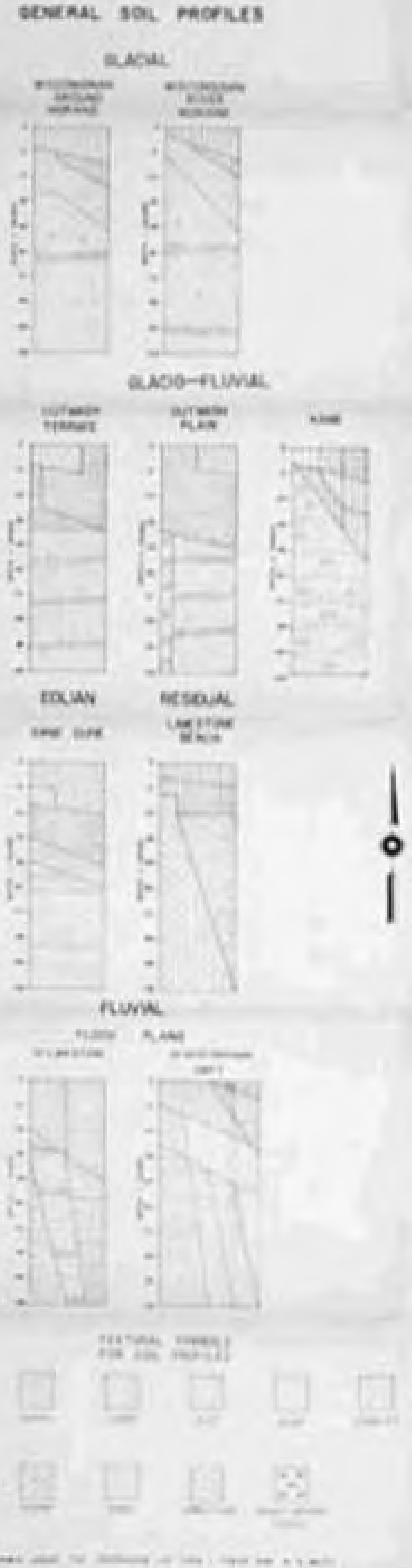
Appendix (cont.)

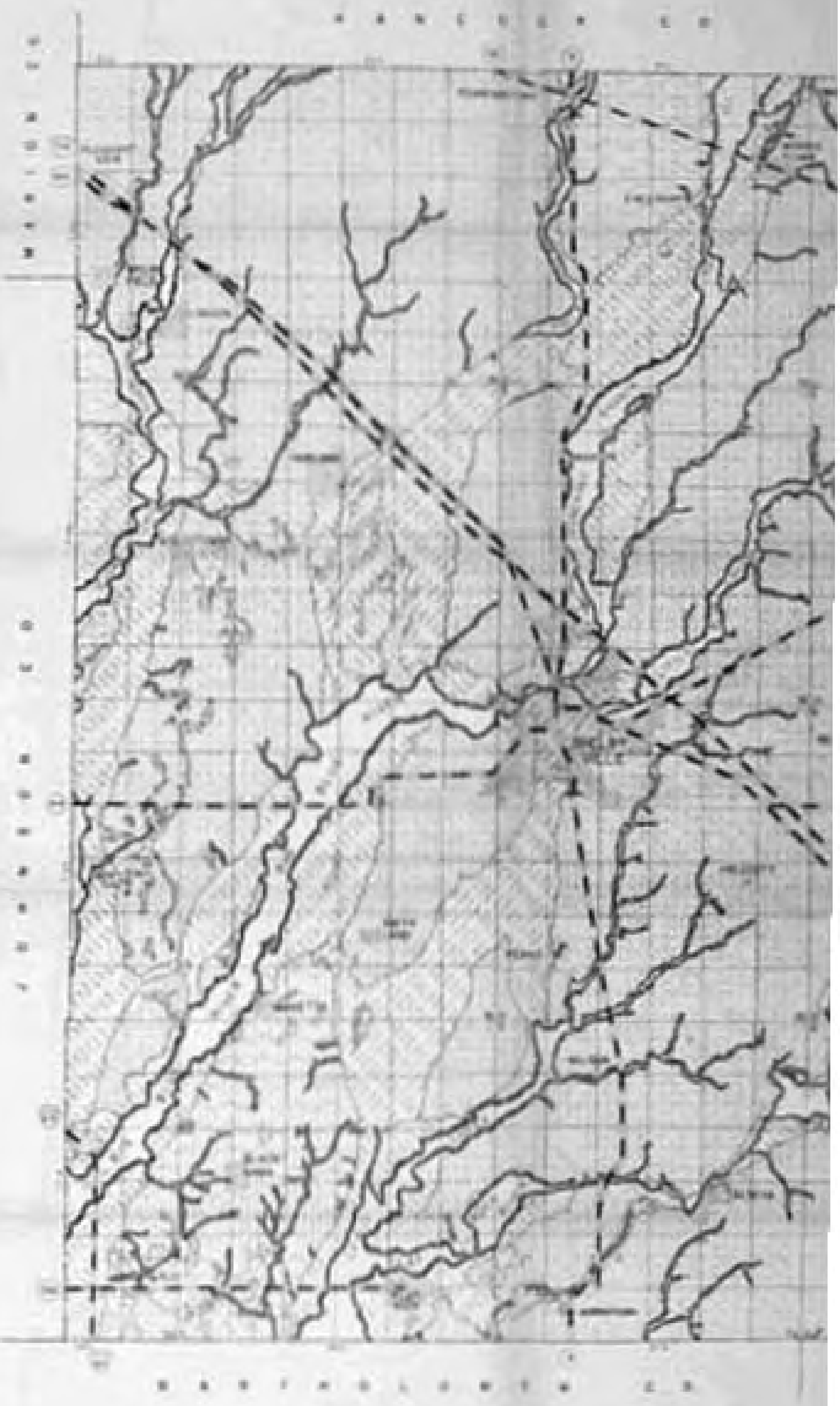
Borehole Number	Highway Route	Station	Offset	Surface Elevation	Depth	Soil Description: Texture	Soil Description: AASHO	SPT	LL	PL	PI	Notes
		feet	feet		feet			blows/foot	%	%	%	
15	SR 44	167+25	CL	736	0-3	med. stiff LOAM	A-1	9				
					3-5.5	med. stiff CLAY LOAM w/ some Gra	A-6(7)	9	36	19	17	γd_{max} = 108.7 pH = 6.7
												ω_{opt} = 16.7
					5.5-10	v. loose SAND w/tra GRA	A-2-4(0)	4,2				CBR = 3.7 18% fines pH = 7.6
					10-12.5	med. dense SANDY GRA	A-1-a	12				
16	SR 44	178+00	25'R	749	0-4	med. stiff to stiff LOAM	A-6(4)	11	28	17	11	ω_n = 17.1
					4-8	med. stiff to v. stiff SILTY CLAY LOAM	A-6	22				
					8-10	dense SANDY LOAM		49				
INTERSTATE 65 OVERPASS FOR STATE ROAD 252 [18].												
17	I-65 over SR 252	3798+93	64'L	679	0-2.5	med. stiff SILTY CLAY LOAM		7				
					2.5-5.5	stiff SANDY CLAY LOAM		13				
					5.5-10	med. dense SAND & GRA		12				
					10-20	med. dense SAND		12,25				water at 14'
					20-51.5	med. dense to dense SAND & GRA		21,24,23,46,40,52,34				
18	I-65 over SR 252	3798+95	64'R	679	0-2.5	stiff SILTY LOAM						
					2.5-4.5	loose SANDY LOAM		5				
					4.5-26	med. dense SAND & GRA		18,36,25,24				water at 18'
					26-30	med. dense SAND		20,24				
INTERSTATE 65 [19].												
19	I-65	139+00	42'L	681	0-2	stiff CLAY w/tra organic	A-7-6					
					2-6	med. stiff SANDY LOAM	A-2-4					
20	I-65	169+50	CL	671	0-2.5	soft LOAM w/tra organic	A-7-6	5				
					2.5-4.5	med. stiff CLAY LOAM	A-6	7				
					4.5-10	med. dense SAND	A-1-6(0)	18,28				
21	I-65	180+34	60'R	674	0-2	soft SANDY SILT		1				
					2-4	stiff SANDY SILT		7				
					4-41	loose to med. dense SAND & GRA		8,14,24,25,32,30,25,26				
					41-48	med. dense to v. dense SAND & GRA		77				
					48-56.5	hard SANDY SILT w/Gra		61,68				

Appendix (cont.)

Borehole Number	Highway Route	Station	Offset	Surface Elevation	Depth	Soil Description: Texture	Soil Description: AASHO	SPT	LL	PL	PI	Notes
		feet	feet		feet			blows/foot	%	%	%	
22	I-65	183+05	57'L	673	0-2	soft CLAYEY SILT		1				
					2-6.5	v. soft to med. stiff SANDY SILT		2,6				
					6.5-20.5	med. dense SAND & GRA		12,22				
					20.5-26	dense fine SAND		33				
					26-41	dense SAND & GRA		31,41,36				
					41-51.5	med. dense SANDY SILT & GRA w/sand layers (hardpan)		26,55,43				
23	I-65	209+45	42'L	709	0-1.5	med. stiff SANDY LOAM	A-2-6					
					1.5-5	dense CLAY LOAM	A-4					
					5-13	med. stiff SANDY LOAM	A-2-6					
					13-26	dense SAND	A-1-6					
24	I-65	222+35	42'L	715	0-10	med. stiff CLAY LOAM	A-6					
25	I-65	238+00	42'R	746	0-0.2	topsoil						
					0.2-5	med. stiff CLAY LOAM	A-6					
					5-9	med. stiff CLAY LOAM	A-6(5)					
					9-27	dense SAND	A-1-6	36,39				
					27-31	v. dense SAND		56				
					31-44	dense SAND		38,40				
					44-48	v. dense SAND		51				

JHRP_ 86/15





ENGINEERING SOILS MAP

SHELBY COUNTY

INDIANA

PREPARED FROM

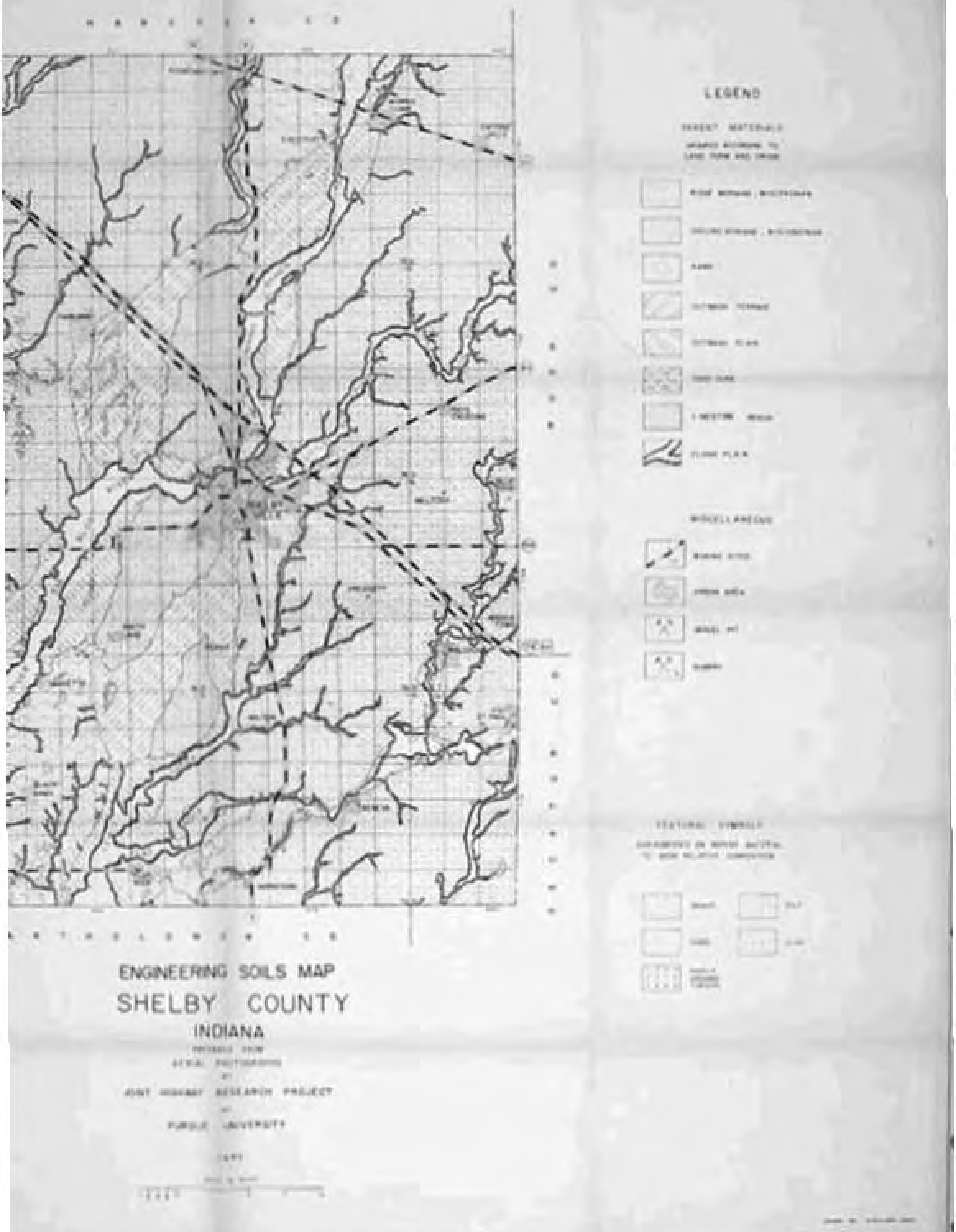
AERIAL PHOTOGRAPHS

BY

JOINT HIGHWAY RESEARCH PROJECT

AT

PURDUE UNIVERSITY


LEGEND
ENGINEERING SOILS MAP
SHELBY COUNTY
INDIANA